LAYING GAS MAINS.

BY HAZELTINE.

The laying of natural gas mains is a new branch of the profession which has sprung up in the last three or four years, and being new we have no works on the subject as we have in all other branches of engineering. Very little has been written, except by theorists and cranks, on the subject.

And I venture to say there is no enterprise in this or any other country in which up to the present time so little engineering skill has been used as in the conducting of natural gas long distances.

But experience is teaching the people that the near future will require the employing of the very highest skilled engineers that can be had and as in all other great enprises their plans and calculations will be carried out in a minute detail.

It is not the intention of this paper to attempt to describe in detail how natural gas mains have been laid or how they should be laid; but in a hasty manner the general way of laying mains for conducting natural gas over long distances.

As in all enterprises of this character the route is the first problem considered. In this the most direct line to point of destination is universally taken. The cost of the pipe being the greatest factor. Hills, hollows and streams are lightly considered. The pipe is layed over the hill and across the valley and under the rivers or creeks as the case may be. Both cast and wrought-iron pipe is used in piping gas. Cast-iron pipe is rarely used outside of cities, where it is used in large sizes, such as 24 and 36 inch pipe, to act as conductor and reservoir combined. Wrought-iron pipe is used almost exclusively on long lines and is usualy eight or ten inches in diameter. The joints have furnished a fine field for inventors, and to enumerate the various kinds, if I could, would require a longer article than I expect to write. The plain screw and lead joint are most in use. And in this paper I shall confine myself to the plain screw joint.

The pipes are intended to be twenty feet long, but average seventeen. The medium ten-inch pipe weighs thirty and the standard forty pounds per foot. Each pipe weighing respectively 600 and 700 pounds.

Outside the cities and towns the pipe is usualy screwed together on top of the ground. The trench is dug after and the pipe is shoved over it on skids and lowered in sections by means of hand spikes. Where the line is over ground where the digging is hard, such as rocks or roots, they cover the pipe as it lays on the surface. This is called mounding the pipe.

The laying of the pipe is the most particular part of the work. It requires skill, strength and endurance, and is the hardest work I ever saw men do. The pipe "gang"

as it is called, consists of twenty-five men, and is composed of a superintendent, a "stabber," as he is termed, who stands at the front end of the pipe and has it placed in position to be screwed into the last section laid. This requires a mechanical eye and practice. He has the pipe laid on two jacks and held by a man. The entering end is held so that it is loose in the sleeve by two men by means of a belling iron, as it is called. The jacks are in such a position that the pipe inclines at an angle of about 30 degrees. When it is in line with the main, with the aid of from four to six of the tongs—men who have ropes under it—he screws the pipe in as far as he can. If the threads are crossed or the pipe is not in line, it will not turn by this means and it is backed out and started again. After it has been partially run up it commences to run hard. One pair of tongs is dropped on, after a few turns another, and so on until the fourth pair is on, each pair of tongs weighing about 150 lbs. They are worked by four men on each pair—sixteen men in all—who break stroke, as it is termed; that is, one pair is drawing while the others are going back. This keeps the pipe rolling constantly until it is screwed up. There are two pairs of chain tongs fastened on the last pipe and each held by one man, called a holdback, and one man who takes the rings off, which are screwed on to protect the thread while being shipped, who also paints the pipe after it is screwed together and before it is ditched, completes the outfit. Great care is taken not to remove the rings until they are ready to use the pipe; the fresh thread runs up much easier than after it has been exposed to the atmosphere for an hour or two. In laying a line either up or down a hill, the trench is dug in such a manner that it will give it a gentle curve. The pipe is laid as far beyond the depression as possible, and then fires are built under it, where the bends occur. As it becomes heated it drops gradually and conforms to the shape of the ground. The cost of laying depends measurably upon the country over which it is being laid. In an open country and on a straight line, with the pipe delivered close at hand, a gang will lay on an average twelve hundred feet per day, at an expense for labor alone of $55, about $250 per mile. In the country on clear and comparatively level land, 55 laborers, with a labor boss, water boy and blacksmith, will ditch lower and cover a mile of pipe in six days at an expense of about $535. A 10-inch pipe weighing 30 pounds per foot, costs about $1.70 per foot or $8,976 per mile. After the pipe is laid in the trench and before it is covered, each joint is calked by driving the edges of the out-side pipe compactly against the inside. The joint is then tested by applying a strong mixture of soap-suds with a brush, the least leak can readily be detected as it will produce a soap-bubble, where they appear the joint is again gone over and again tested until it is perfectly tight. This costs from 50 cts. to $75.00 per mile. The cost of a mile of pipe under the most favorable circumstances by these four items is $9,823.50.

As the laying of the line progresses, gates or valves are put in

at various places in order to turn the gas into other lines, or to shut it off in case an accident occurs to the line. When a gate has been put in, the line is tested; when the initial point is at the well it is done by turning on the gas; when the line is not connected with a well, it is done by compressed air, which is forced in the line by a common air pump attached to an upright boiler, mounted on a low car with broad wheels, so that it can be moved from place to place as the case requires. The pressure to which the line is tested, varies with different companies and by the ordinances of different cities, and the character of the line. Low pressure lines are tested from ten to thirty lbs. per square inch, while high pressure lines are tested up to forty and sometimes seventy lbs. per inch.

The piping of cities is the most expensive part of the line. The streets are hard, often being filled with foreign substances and from travel. The pavements have to be torn up and crossings removed. The trench which is dug before the pipe is laid has to be bridged at all the street crossings as well as drives to business houses and residences. These have to be guarded at night with lights, and watchmen are kept on the line to see that they are kept burning.

Sewers, water mains and gas lines have to be avoided, private drains and water and gas connections are encountered, and all must be protected. The pipe "which is usually forty bbl. per foot," is laid in the same manner as before described except that it is laid in the ditch, which makes it much harder to get at. When an angle occurs in the street or for any reason the course of the pipe is changed, the pipe is heated by building a fire around it at the point of making the bend. When it is thoroughly heated a shore or brace is placed just back of the fire and by the aid of levers the pipe is bent, care being taken before hand to have the angle come as near the middle of the pipe as possible. If the angle is greater than 20 deg., it requires more than one bend to make the turn. The bends are spaced off in cords of equal length of pipe, being laid.

If the pipe is forty lb. standard when well heated and carefully braced, it will stand a bend of 15 deg. without buckleing. It is dangerous to attempt to bend it more in one place. Thirty lb. pipe will not stand as great a bend as the forty; it is not safe to bend it more than 10 or 12 deg.; a six inch pipe will bend 15 deg. without being heated. When a pipe is buckled it decreases its size to the extent of the size of the dinge and reduces the capacity of the line ahead of it nearly to the size of the pipe where it is injured; that is if a ten inch line has a buckle at the angle which reduces the aperture to the size of a six inch pipe, the rest of the line might as well be of six inch pipe. It usually requires an hour to heat the pipe and make the bend, during which the pipe "gang" is idle; you will readily see that each bend costs at least five dollars. Streets are often too narrow to make the number of bends necessary, and an elbow has to be cast to fit the angle, which is the case when it is necessary to make a right angle. They are connected with the line with a flange union; being of cast iron, are more liable to break, and

should be avoided as much as possible.

The depth to which gas mains should be laid is a subject of much discussion, and the advocates of each plan are divided into districts, which for convenience we will call the northern and southern districts. In the northern we will include all the lines supplying gas to cities, north and west of Pittsburg. In this district the plan is to lay the pipe from 2½ to 3 feet below the surface, in what is termed the frost line.

The advocates of this plan claim that if pipe laid below the frost line should leak, the gas being about half as heavy as air will raise until it enters the crevice below the frozen ground and travel in it great distances, and is liable to do much harm. While, if it is in the frost line, the frozen earth below will prevent its descending into the crevice, and the frozen ground on each side and above prevents its escape at all, so that it is literally confined in a casing of frost. The frost goes out at the top first, and the gas escapes through the surface before the frost goes out below the pipe.

In the southern district we will include all the lines supplying Pittsburg, Allegheny and the neighboring towns, where they advocate laying the pipe from 4 to 4½ feet deep; claiming that it being below the frost line the temperature remains uniform, and if the line is once tight it will remain so for all time. Laying pipe at this depth adds greatly to the cost of the line, and my estimates are made on the basis of laying pipe in the frost line.

Gasometers are used to regulate the pressure at points of distribution, and there are a great many kinds being introduced on the various lines. I shall only attempt to describe the one in most general use. It is constructed on the plan used at the gas works in our cities, is of boiler iron and ceiled with oil, instead of water to prevent its freezing. The gas is brought into the bottom of it by a pipe from the high pressure main, in which is a valve with a lever 3 or 4 feet long, to which is attached a chain which passes upward over a pulley and is attached to the top of the receiver, which is set at the required height to hold the amount of gas it is expected to distribute. As the receiver raises above that level, the lever drops and checks the flow of gas; as the receiver drops the lever raises and opens the valve, working automatically. The pressure on the lines leading from a gasometer is regulated by placing weights on top of the receiver. New and improved devices for regulating the flow of gas are being constantly introduced and it probably will not be long until the one that I have attempted to describe will be among the things of the past.